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PATENT SPECIFICATION

DRAWINGS ATTACHED

833,359

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COMPLETE SPECIFICATION

Process for the Manufacture by Welding of Jointed Pipes of Thermoplastic Material

We, FARBWERKE HOESCHST AKTIENGESELLSCHAFT vormals Meister Lucius & Brüning, a body corporate recognised under German law, of Franfurt (M)-Hoechst, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process and a device for the manufacture by welding of jointed pipes of thermoplastic material.

It is known to joint plastic pipes, for example pipes made from polyvinyl chloride, by means of welded seams using additional welding material. In this process it is customary to weld butt joints which have been prepared by turning, milling, grinding, filing or rasping, mostly in V-shaped butt welds, by means of welding rods or welding strips and using a hot air apparatus. This process which has proved to be advantageous for pipes made from hard polyvinyl chloride—skilled welders in general attain a quality coefficient of 0.6—cannot be applied equally well to pipes made from other plastics. Especially in the case of pipes made from polyethylenes, the thermal decomposition of the plastic which cannot be avoided when welding small cross sections detrimentally affects the strength properties of the welded seam.

For the joining of plastic pipes, especially pipes made from hard polyvinyl chloride, welding by heating elements is also known. According to that process the ends of the pipes which have been cut perpendicular to the longitudinal axis are heated to welding temperature by means of a heating plate and welded by compressing them. The quality of such welded joints cannot be expressed in figures since generally recognized testing methods do not exist. When applying this process to other plastic pipes, especially pipes made from polyethylene, joints of insufficient strength are obtained. Moreover, free passage through the pipes is impeded by the internal ridge produced; in the case of small pipe cross-sections this may even lead to obstruction.

It is also known to fit plastic pipes together by interposing a metal ring or other shaped metallic article and to carry out the welding by means of induction heating. The metal inserts remain part of the joint which, therefore, cannot be used for many purposes, especially for many types of pipe lines.

In the metal industry it is customary to form a lap-joint between 2 pipes by welding the edge of the outer pipe to an inserted pipe or, as is the case with the so-called Iraq sleeve-joint, to fit together the ends of the pipes, which have been enlarged to form sleeves, over a nipple and to weld the meeting edges of the sleeves by means of a V-butt weld. If plastic pipes are joined according to these two processes, reductions in strength occur when preparing the seams owing to the thermal decomposition.

The present invention provides a process for the manufacture by welding of jointed pipes of thermoplastic material, wherein the surfaces of parts to be lap-jointed are transformed by heat into a pasty-fluid form over the whole circumference and substantially along the whole length of the portions of the pipe which will overlap when the pipes are joined, then brought together and allowed to cool or cooled.

The process according to the invention is applicable to pipes made from thermoplastic material, especially from polyethylene and polyurethane, from polyvinyl chloride, polystyrenes or polyacrylates.

It has proved—and this is surprising—that even if the pasty-fluid form of the surfaces which are to be brought into contact is only produced in a superficial manner, a sufficient jointing of the parts is attained to satisfy all practical requirements. In dif-

ferent cases it may be expedient to transform the thickness of the wall of the pipe to a varying extent into the past-fluid form. It depends in general on the wall thickness of the pipes to what extent the depth of softening of the pipe wall is most suitably carried out. When working with wall thicknesses of about 1 mm to about 2 mm, the softening may be carried out in a zone of about 5 per cent to about 50 per cent of the thickness; when the wall thicknesses are about 2 mm to about 20 mm, the softening may be carried out in a zone of about 5 per cent to about 80 per cent of the wall thickness. If desired, there may also be used parts with wall thicknesses exceeding 20 mm.

By softening is understood the transformation of the plastic, of which the parts of the pipes which will overlap when the pipes are joined consist, into the plastic-deformable state which renders it possible to attain a solid joint of the parts after these parts have been fitted one into another and allowed to cool.

The surfaces to be welded may be softened by a hot current of gas or air, produced for example by a known hot-air welding apparatus, by an open flame—for instance by means of a ring burner—or by a heater which, for example, is brought to the correct temperature by means of electric resistances.

In some cases it is advantageous to bring the parts to be joined to welding temperature by dipping them into hot liquids; in these cases care must be taken, for example, by covering the parts which are not to be treated, that only the surfaces to be welded come into contact with the liquid.

The temperature necessary in order to bring about the softening of the plastic to the required extent depends on the nature of the plastic. In general, these temperatures are between about 200° C. and about 800° C. The temperature is at least 80° C. above the softening point of the thermoplastic material used; it may, however, also be considerably higher than 80° C. If the parts consist of polyethylene, it is expedient to heat to temperatures of between about 200° C. and about 600° C. a temperature of about 600° C. has proved to be especially advantageous. Polyvinyl chloride requires a temperature of about 200° C.

The softening process by means of which the required fraction of the thickness of the pipe wall, as described above, is transformed into the pasty-fluid form, requires in general comparatively little time. For example, about 7 to 10 seconds suffice for parts made from polyethylene, and 10 to 15 seconds for parts made from polyvinyl chloride.

After the thickness of the pipe walls of the parts to be joined has been transformed into the softened pasty-fluid state to the required extent, the parts are joined in the desired manner.

After the parts have been brought together, the joint obtained may be allowed to cool, for example by simply resting it. The joint may also be quenched, for example by dipping it into water, oil or other suitable liquid. It may also be sprayed with such liquids, or cold or cooled air may be blown on to the joint, in which case the air should suitably have a temperature of between about 15° C. and 30° C.; however, also air of a lower temperature than 15° C., say 0° C., may be used.

A particular mode of execution of the invention consists in mechanically manipulating either or both of the parts of the pipes which will overlap when joined, prior to exposing them to the softening process by heating, for example in order to produce stressed or unstressed deformation, in such a manner that the outer diameter of the part to be inserted is greater than the respective internal diameter of the outer part or parts. Suitably the internal diameter of the outer pipe should be smaller than the outer diameter of the part to be inserted therein by about 10 per cent of its wall thickness and by at least 0.5 mm. On fitting together the outer part and the part to be inserted therein, the excess dimensions of the part to be inserted have the effect that part of the softened mass is removed so that ridges are formed immediately in front of and behind the weld. The quality of the weld may be inferred, during the welding operation, from the formation of the externally visible ridge, inasmuch as a successful weld of high quality as a rule produces a pronounced, evenly formed accumulation of the material.

By employing the process according to the invention, a high-quality weld of the outer part of the lap with the part to be inserted therein is attained. The process according to the invention can, for example, be employed in order to prepare a lap-joint by using a sleeve of usual construction (tulip-shaped sleeve).

The invention is illustrated in the accompanying drawings in which:—

Fig. 1 is a lap-joint where the overlapping portion of the outer pipe is tulip-shaped.

Fig. 2 is a lap-joint where a sleeve is inserted over the ends of the pipes to be joined. In making this joint first the end of an upper part of a pipe is joined to the upper part of a sleeve of a convenient diameter. The end of the lower part of a pipe is then joined according to the invention with the lower part of the sleeve.

Fig. 3 shows a lap-joint formed by inserting a sleeve within the end portion of the pipes to be joined—each end portion being tulip-shaped.

Fig. 4 shows a lap-joint formed between

a plastic pipe of a larger diameter and a plastic pipe of a smaller diameter.

Fig. 5 shows a T-joint.

Figs. 6, 7 and 8 show lap joints where the portions of the pipes which overlap are conical in shape, while Fig. 9, shows one example of a ball-sleeve joint.

Referring to Figs. 2 and 6, there are shown at 1 the ridges produced on fitting the parts together, these ridges being omitted from the other figures referred to above.

Apart from the means required for the heating of the surfaces to be welded, a lap joint can be welded by the process of the invention without special apparatus and at any suitable place. Even an operator who is unskilled in the welding of plastics soon discovers how long the surfaces to be joined should be exposed to the selected source of heat so that only so much of the plastic material is transformed into a pasty-fluid form as is required to produce the weld.

In order to heat up the surfaces to be joined, a pair of tongs, as shown by way of example in Fig. 10, is advantageously used, of which the jaws are provided with a divided heating ring 2. There may also be used a pair of tongs, as shown by way of example in Fig. 11, provided with a divided heating mandrel 3. Ring 2 and mandrel 3 are heated in a forge, by means of a burner or in a fluid bath, and are then applied to the surfaces to be heated. The mandrel, the ring or the like parts of the tongs can also be equipped with electrical resistance heating. The tongs are shaped to facilitate the application of the heating elements and to prevent deformation of the lap joint parts. The tongs can also be constructed with interchangeable rings or mandrels for different forms or sizes of the pipes to be joined.

The process according to the invention can furthermore, advantageously be carried out in such a manner that the pipes to be joined are centered on a common longitudinal axis and are clamped in this position in such a manner that they can be moved longitudinally. This manner of operating is, for example, applied to a lap joint which is diagrammatically illustrated in Fig. 12. Referring to Fig. 12, pipes 4 and 5 are centered on a common longitudinal axis by clamping devices 7 and 8, respectively. The pipe ends can be moved in the pipe axis by means of a gearing whose essential parts consist, for example, of racks 9 and 10 and of a pinion 11. Guides are provided in a bed in known manner. A sleeve 6 is clamped in a clamping device 12 which is fixed to a bell crank lever 13 and can be pivoted on a pivot 14. Lever 13 can be arrested in one end position in such a way that sleeve axis and pipe axis coincide. After the contact surfaces have been heated, the sleeve is swung into the pipe axis and the pipes are brought closer together and inserted into the sleeve by turning the pinion by means of a crank. After clamping devices 7, 8 and 12 have been opened, the finished jointed pipe can be removed.

After the sleeve clamping device has been put out of operation, the same device can also be used to make joints according to Figs. 1, 4, 6 and 7.

When using pipes of certain materials, for example such material as tends to oxidize in the hot, it is expedient to carry out the heating and welding operation in an atmosphere of protective gas. As protective gas there may be used, for example, argon, helium, nitrogen or other inert gas. This can be achieved, for example, by casing the device illustrated in Fig. 12. It is advantageous to use a transparent casing which also includes the heating installations.

WHAT WE CLAIM IS:—

1. A process for the manufacture by welding of jointed pipes of thermoplastic material, wherein the surfaces of parts to be lap-jointed are transformed by heat into a paste-fluid form over the whole circumference and substantially along the whole length of the portions of the pipe which will overlap when the pipes are joined, then brought together and allowed to cool or cooled.

2. A process as claimed in Claim 1, wherein the surfaces of the parts of the pipes will overlap when the pipes are joined are only superficially transformed into a pasty-fluid form.

3. A process as claimed in Claim 1 or 2, wherein the wall thickness of the pipes is about 2 mm to about 20 mm. and the surfaces of the parts of the pipes which will overlap when the pipes are joined are transformed into a pasty-fluid form in a zone of about 5 per cent to about 80 per cent of the whole thickness of the pipe wall.

4. A process as claimed in any one of Claims 1—3, wherein the wall thickness of the pipes is 1 mm. to 2 mm. and the surfaces of the parts of the pipes which will overlap when the pipes are joined are transformed into a pasty-fluid form in a zone of about 5 per cent to about 50 per cent of the whole thickness of the pipe wall.

5. A process as claimed in any one of Claims 1 to 4, wherein the surfaces of the parts of the pipes which will overlap when the pipes are joined are heated to temperatures of between about 200° C. and about 800° C.

6. A process as claimed in any one of Claims 1 to 5, wherein the surfaces of the parts of the pipes which will overlap when the pipes are joined are heated to temperatures of at least 80° C. above the softening point of the thermoplastic material of which the parts to be joined are made.

7. A process as claimed in any one of Claims 1 to 6, wherein the surfaces of the

parts of the pipes which will overlap when the pipes are joined are heated by an open flame.

8. A process as claimed in any one of Claims 1 to 6, wherein the surfaces of the parts of the pipes which will overlap when the pipes are joined are heated by a hot current of gas or air.

9. A process as claimed in any one of Claims 1 to 6, wherein a surface of one of the parts of the pipes which will overlap when the pipes are joined is heated by a heating body applied thereto.

10. A process as claimed in any one of claims 1 to 9, wherein the surfaces of the parts of the pipes which will overlap when the pipes are joined are heated and welded under protective gas

11. A process as claimed in any one of Claims 1 to 10, wherein the hot jointed pipe is cooled by dipping it into a liquid or by spraying it with a liquid or by blowing air on to the joint.

12. A process as claimed in any one of Claims 1 to 11, wherein a sleeve and/or the part to be inserted therein, prior to heating, is deformed with or without residual stress so that the external diameter of the part to be inserted is greater than the respective internal diameter of the sleeve.

13. A process for the manufacture by welding of jointed pipes of thermoplastic material, conducted substantially as described herein.

ABEL & IMRAY,
Agents for the Applicants,
Quality House, Quality Court,
Chancery Lane, London, W.C.2.

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Fig.1

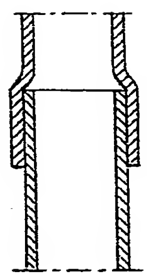


Fig.2

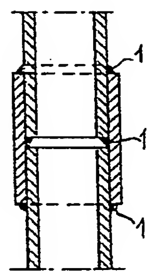


Fig.3

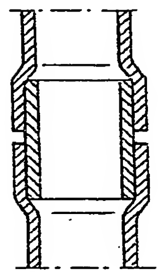


Fig.4

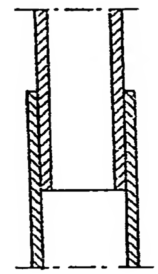


Fig.5

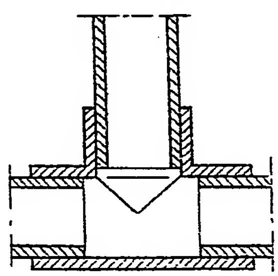


Fig.6

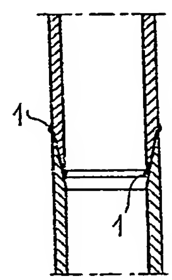


Fig.7

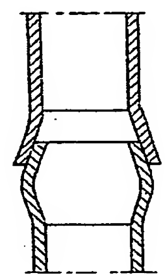


Fig.8

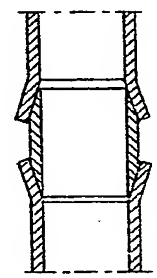


Fig. 9

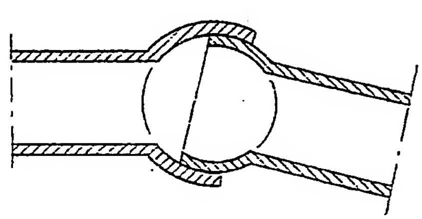


Fig.10

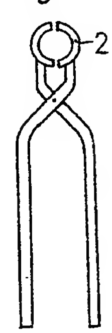
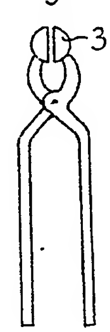


Fig.11



833,359 COMPLETE SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

Fig. 4

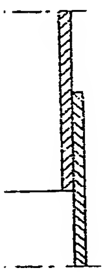


Fig. 8

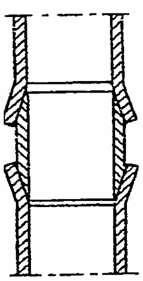


Fig. 11

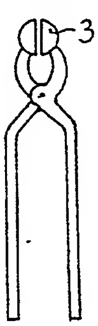


Fig. 12

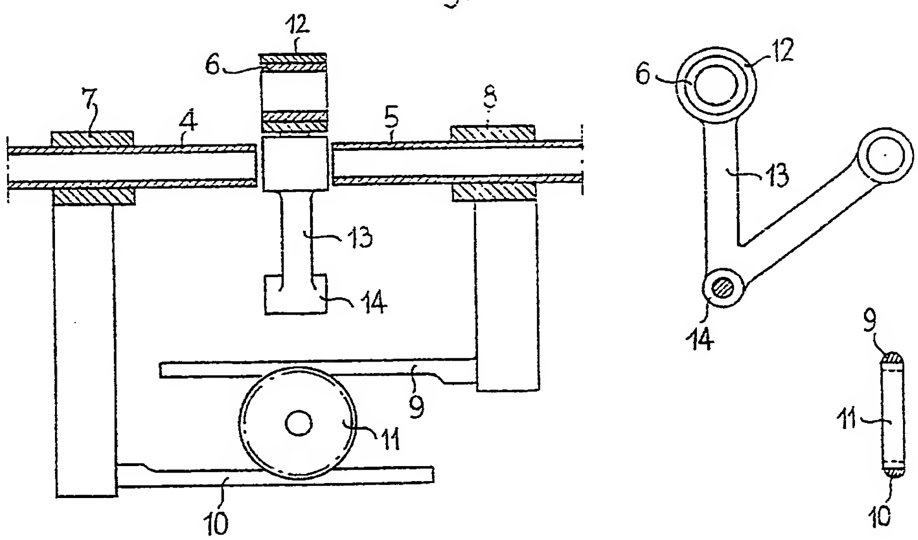


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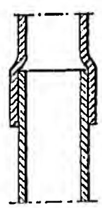
Fig.1


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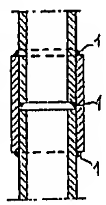

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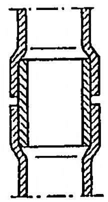


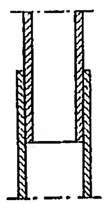
Fig.4


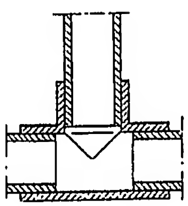
Fig.5


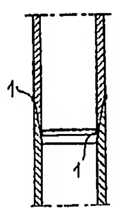
Fig.6


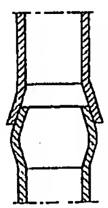
Fig.7


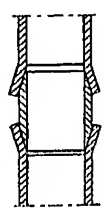
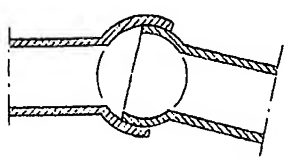
Fig.8


Fig. 9


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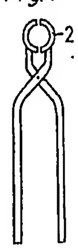

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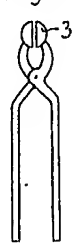

Fig. 12